Title: Triangles

Brief Overview:

Students will be introduced to three types of triangles: equilateral, scalene, and isosceles. They will use manipulatives to build each of the three types, classify triangles based on their side attributes, and make models to test rules they have learned about triangles. The culminating activity will require students to use this information to design a stained glass window pattern, and write a persuasive letter to their school PTA.

Links to NCTM Standards:

- **Mathematics as Problem Solving**
  Students will demonstrate their ability to solve problems in mathematics including problems with open-ended answers and problems which are solved in a cooperative atmosphere.

- **Mathematics as Communication**
  Students will demonstrate their ability to communicate mathematically. They will read, write, and discuss mathematics with language and the signs, symbols, and terms of the discipline.

- **Mathematics as Reasoning**
  Students will demonstrate their ability to reason mathematically. They will gather evidence and build arguments.

- **Mathematical Connections**
  Students will demonstrate their ability to connect mathematics topics within the discipline and with other disciplines.

- **Number Concepts & Relationships**
  Students will demonstrate their ability to solve problems using arithmetic operations.

- **Geometry and Spatial Sense**
  Students will demonstrate their ability to apply geometric relationships to models. They will demonstrate similarity and apply this concept to the solution of the geometric problem.

- **Patterns and Relationships**
  Students will demonstrate their ability to create and explain a pattern.

Grade/Level:

Third to Fifth Grade

Duration/Length:

3-4 class sessions (variable)

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Attributes of a triangle
- Number sentences using < and > symbols
- Basic addition facts
- Repeating pattern using geometric shapes

Objectives:

Students will:

- learn the three classifications of triangles according to the lengths of the sides.
- write a rule about the length of the sides necessary to create a triangle.

Materials/Resources:

For each group of 3 - 4 students:

- Coffee stirrers, 20 full length, 20 cut into 3/4 length size, 20 cut into 1/2 length size, and 20 cut into 1/4 length size
- Pipe cleaners, about 30, cut into 1 inch segments
- Index card
- Student Resource 2: Triangle Patterns (precut on oak tag, construction paper)

For each individual student:

- Dot paper
- 10 strips of 3/4 inch grid paper; pre-cut into 3/4 inch by 12 inches, reproduced on oak tag, construction, or sturdy paper
- Colored pencils
- Student Resource 1: Making Triangles
- Student Resource 3: Our School Window (teacher may enlarge as desired)
- Student Resource 4: Writing Prompt

For Extension/Follow up activity (optional)

- 20 inch by 20 inch piece of clear Heavy Duty Saran Wrap
- Markers
- Black construction paper (for borders)

- Scissors
- Glue

Teacher needs:

- Chart paper or chalkboard to display triangle examples
- Overhead, chart paper, or chalkboard for number sentences
- Masking tape
- Teacher Resource 1: Rules Poster
- Teacher Resource 2: (3/4" x 12") Grid Paper, precut into strips on oak tag
- Teacher Resource 3: Making Triangles Answer Sheet

Additional Resources:

- "Materials and Techniques of Art: A Resource Kit," A Classroom Teaching Guide.
- "I Can See Clearly Now," Authors: Gibson, Edwin C. Gibson, Jane B. Classroom instructional material and teaching guide.
- "Architectural Heritage: An Experiment in Montreal's Schools" Author: Leveille, Chantal. Classroom teaching guide.
- "Getting Off on the Right Foot in Elementary Art" Author: Joff, Ardith. Classroom teaching guide.
- "Stained Glass Windows" Author: Overbaugh, Uarda T.
- "Stained Glass Design Goes Mod" Author: Moore, Rosanna
- The Hungry Triangle Author: Marilyn Burns

Development/Procedures:

Pre-Assessment:

Engage the students by looking at a variety of stained glass windows (See additional resources; also the National Gallery of Art in Washington, D. C. has slides that may be borrowed.). Encourage students to pay particular attention to the geometric shapes. Use questioning to encourage students to include geometric terms such as similar, congruent, and to identify a variety of polygons.

Introduction

Your school's PTA wants to celebrate the unity between parents, teachers, and students. They have purchased a triangular window frame as a symbol of this unity. The PTA is sponsoring a contest to create a geometric design for the new front stained glass window.

The rules of the contest are as follows:
(Display graphic for rules for contest.)

1. Your design must include a repeating pattern.
2. Your design must include the three kinds of triangles:
   equilateral, isosceles and scalene.
3. Each of the kinds of triangles must be colored in a specific color
4. Write a letter to persuade the PTA that your design is the best one for the project.

Activity 1

Pass out coffee stirrers and pipe cleaners to each group of 3 - 4 students.
Ask students to make as many different closed shapes as they can by joining only 3 stirrers together at their ends. Demonstrate how to do this by inserting the pipe cleaner into the ends of 2 stirrers. Bend to form an angle. Insert another pipe cleaner into a third stirrer. Connect it to one end of the angle formed. Insert a third pipe cleaner to connect the open end of the triangle. Remind students that they are making as many different sized triangles as possible, not congruent triangles. Allow time for students to explore as many ways as they can for making triangles.

Next, students will classify their triangles into 2 groups. Allow time for students to explore and develop classification categories. Then have each group move to another group. Groups will determine and write the rule that they think was used to classify. Students will return to their original group area. As a class, share and discuss their rules for classifying the triangles.

(4 sheets of chart paper or a board divided into 4 sections are needed at this time)

Say: Mathematicians classify triangles in a number of ways. One way is by the length of the sides. There are 3 kinds of triangle groups that can be made this way. Triangles that have all sides equal are called equilateral triangles (label one paper/section). Equilateral means equal sides, because equi- means equal and lateral means sides. Does anyone have any triangles that have all sides equal?

Have students tape these on the space provided. Check each one for consensus that they are equilateral.

Say: Some triangles have 2 equal sides, and the third side is a different length. These triangles are called isosceles triangles (label the chart/board). Does anyone have any triangles that are isosceles triangles?

Have students tape these on the space you have provided. Check each one for consensus that they are isosceles.

Repeat for scalene triangles (no sides are equal).

Say: Look at the coffee stirrers you have left. Can you make a triangle with any three stirrers? Which stirrers cannot be connected to make a triangle?

Ask students to predict whether this is true or not, and to explain their thinking. As they give examples make each one and demonstrate whether or not they are correct. Put these examples on the space provided. Ask them, in their groups, to write a rule about the lengths of the sides of a triangle.

RULE: The length of the sum of two sides must be greater than the length of the longest side. Or: When 2 coffee stirrers together are not longer than the longest straw, it is impossible to make a triangle.

Possible extension: (homework) Make an organized list of at least two examples of the triangles we identified today that you can find at home.

Performance Assessment:

Activity 2:

Give each child 10 strips (Teacher Resource 2) and a copy of Student Resource 1. Students will fold the strips on the line that indicates the lengths of the sides given for each triangle. They will indicate on the worksheet whether the dimensions formed a triangle or not. They will complete the number sentence, using <, > or =, by applying the rule written that "The length of the sum of two sides must be greater than the length of the longest side." Circulate among students. To assess this activity, you may use an overhead of the worksheet, or pair-check.

Activity 3:

Give each group Student Resource 2 and each Student Resource 3.
Reread the rules for the contest:

1. Your design must include a repeating pattern.
2. Your design must include the three kinds of triangles; equilateral, isosceles and scalene
3. Each of the kinds of triangles must be colored in a specific color
4. Write a letter to persuade the PTA that your design is the best one for the project.

Choose 3 colors to represent each kind of triangle. For the assessment you will want all students to be using the same color for each kind of triangle.

*You may choose to pass out Student Resource 4 at this point or when students are finished with their design.

Writing Prompt

Today you will be writing a letter to persuade the PTA that your design meets all of the requirements of the contest and would be the best design for the new window in the front of your school. Think about what you have learned about triangles. You should include these facts in your letter to the PTA:

- how you decided which triangles were equilateral, isosceles, and scalene
- the pattern you have chosen for your design

Remember that your letter will be read by the parents and teachers in your school. You will want to check your letter for spelling, capitalization, language usage and punctuation.

Assess the writing:
Use limited writing process rubric to score the writing.
Assess content using the prompt.

Assess the design:
Use color match to score students ability to identify the three types of triangles.
Assess patterns based on your students' current level of proficiency with patterns.

Extension/Follow Up:

Make the stained glass designs. Here's how: tape their designs on the desk.
Then have the students tape Saran Wrap over their designs. Using Magic Markers, color the design onto the Saran Wrap. Outline their stained glass window using black construction paper strips as a frame. Display in the classroom.

You may also want to read "The Hungry Triangle" by Marilyn Burns as a way of introducing other polygons.

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Stained Glass Window Design Contest Rules

1. **Your design must include a repeating pattern.**

2. **Your design must include the three kinds of triangles: equilateral, isosceles and scalene.**

3. **Each of the kinds of triangles must be a specific color.**

4. **You must write a letter to persuade the PTA that your design is the best one for the project.**

Grid Paper **Teacher Resource #2**

Making Triangles

Name _____ Date _____

Today you are going to make triangles using grid paper. You will need to count the number of squares for each side of the triangle, fold on the line, and tape the two ends of the triangle. In some of the problems, you may need to cut off extra squares.

Directions

1. Count the number of squares needed for the first side of the triangle.
2. Carefully fold on that line.
3. Count the number of triangles needed for the second side of the triangle.
4. Carefully fold on that line.
5. Do you have any extra squares? These can be cut off.
6. Tape the two open ends together.
7. Complete the chart.

Side 1	Side 2	Side 3	Did You Make A Triangle?		Number Sentence
2	5	5	(YES)	N O	2+5>7
3	3	6	YES	(NO)	3+3=6
3	4	5	(YES)	NO	3+4>5
4	4	4	(YES)	NO	4+4>4
4	3	5	(YES)	**NO**	4+3>5
2	5	5	(YES)	**NO**	2+5>5
2	4	4	(YES)	**NO**	2+4>4
2	5	3	YES	(NO)	2+3=5
1	8	2	YES	(NO)	1+2<8
5:	3	3	(YES)	NO	3+3>5
2	3	7	YES	(NO)	2+3<7

Making Triangles

Name_____ Date _____

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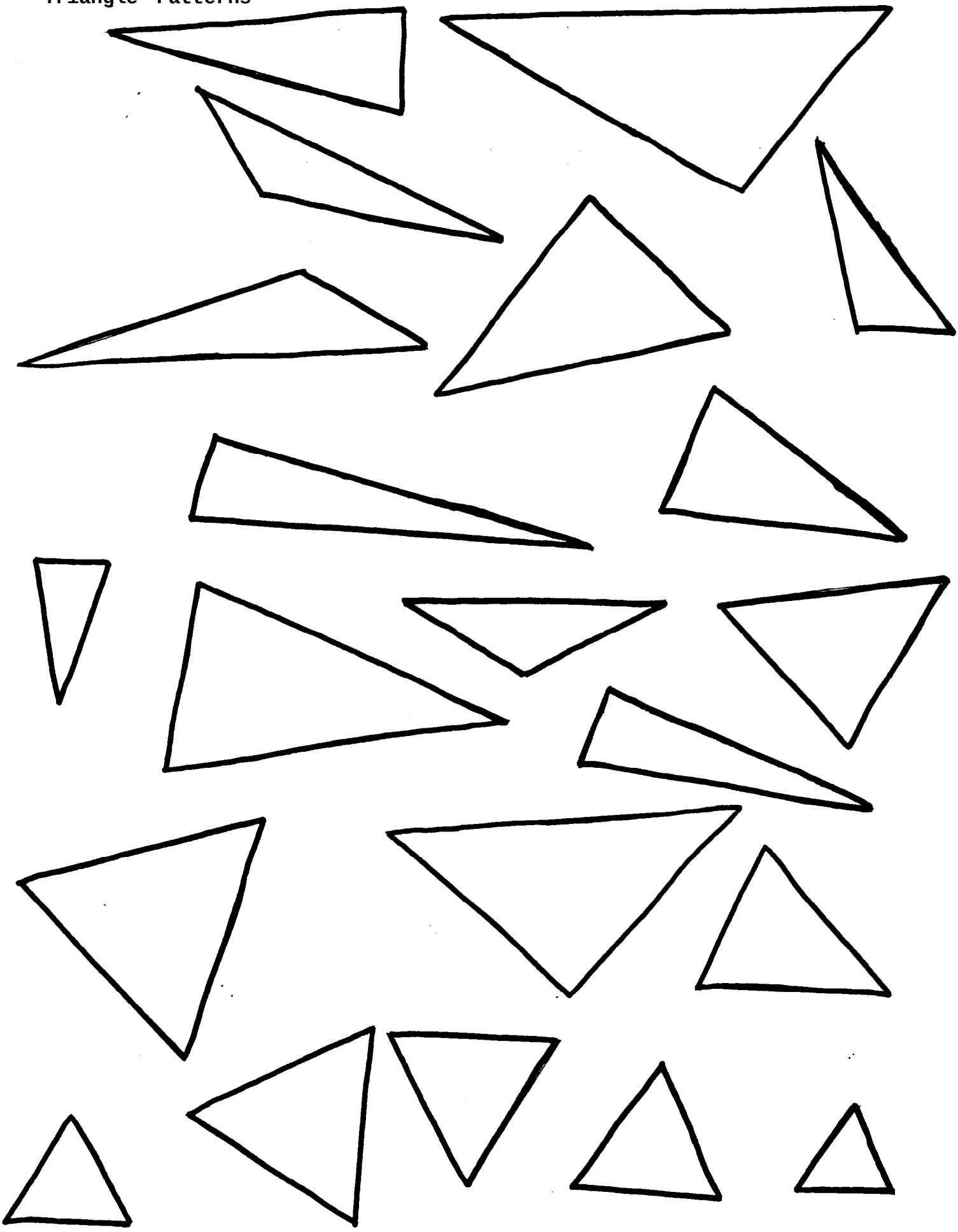
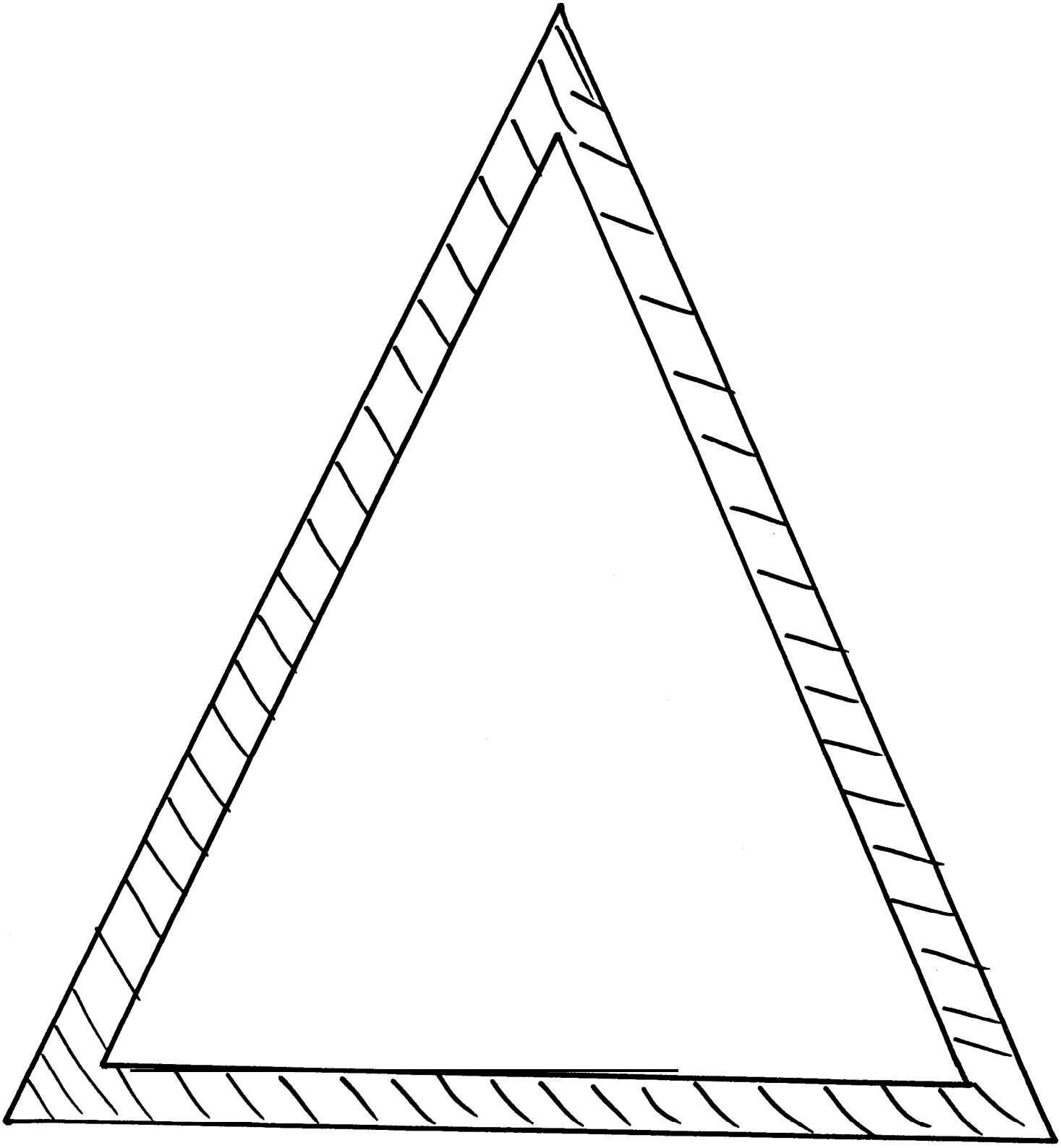
2	5	5	YES	NO	_____
3	3	6	YES	NO	_____
3	4	5	YES	NO	_____
4	4	4	YES	NO	_____
4	3	5	YES	NO	_____
2	5	5	YES	NO	_____
2	4	4	YES	NO	_____
2	5	3	YES	NO	_____
1	8	2	YES	NO	_____
5	3	3	YES	NO	_____
2	3	7	YES	NO	_____

Triangle Patterns



Our School Window

Student Resource #3



WRITING PROMPT:

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